



NASA Aero-Space Enterprise National General Aviation Roadmap

Small Aircraft Transportation System

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Outline

**The “Golden Rule” of the information age is
“Time is the Scarce Commodity.”**

**Early in the 21st century,
transportation demand will soar beyond supply.**

**The Millennial Opportunity:
SATS creates more time for more people.**

- **Small Aircraft Transportation System (SATS)
Concept**
- **National Market Opportunities and Challenges**
- **Suggested Industry Actions**

Solving 21st Century Transportation Challenges



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**The Small Aircraft Transportation System
is a safe travel alternative
that frees people and products from today's system
delays
creating access to more communities in less time.**

The Problem

Executive Summary:

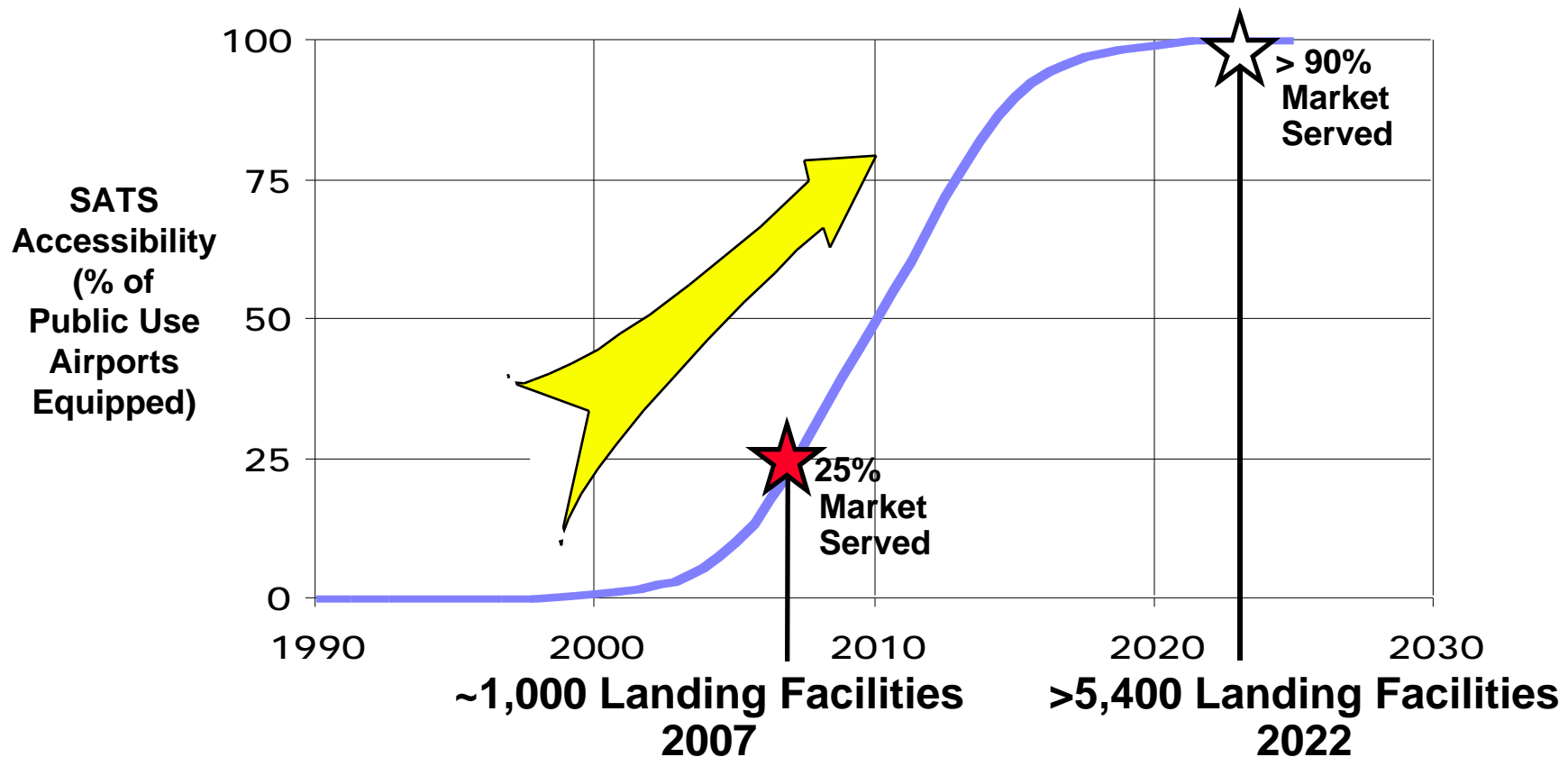
PROBLEM: The nation's 21st century transportation demand cannot be satisfied by the planned investments in hub-and-spoke and highway systems alone*.

SOLUTION: The Small Aircraft Transportation System (SATS) concept can satisfy a large portion of the demand, relieving the pressure on existing ground and air systems.

ACTION NEEDED: National support and coordination is necessary for SATS as a key element in an **integrated national Aeronautics-Transportation investment strategy**.

National General Aviation Roadmap Goal

***"Enable doorstep-to-destination travel at 4 times the speed of highways
Throughout the nation's suburban, rural, and remote communities
Served by Public Use landing facilities."***



Strategic Planning Tenets

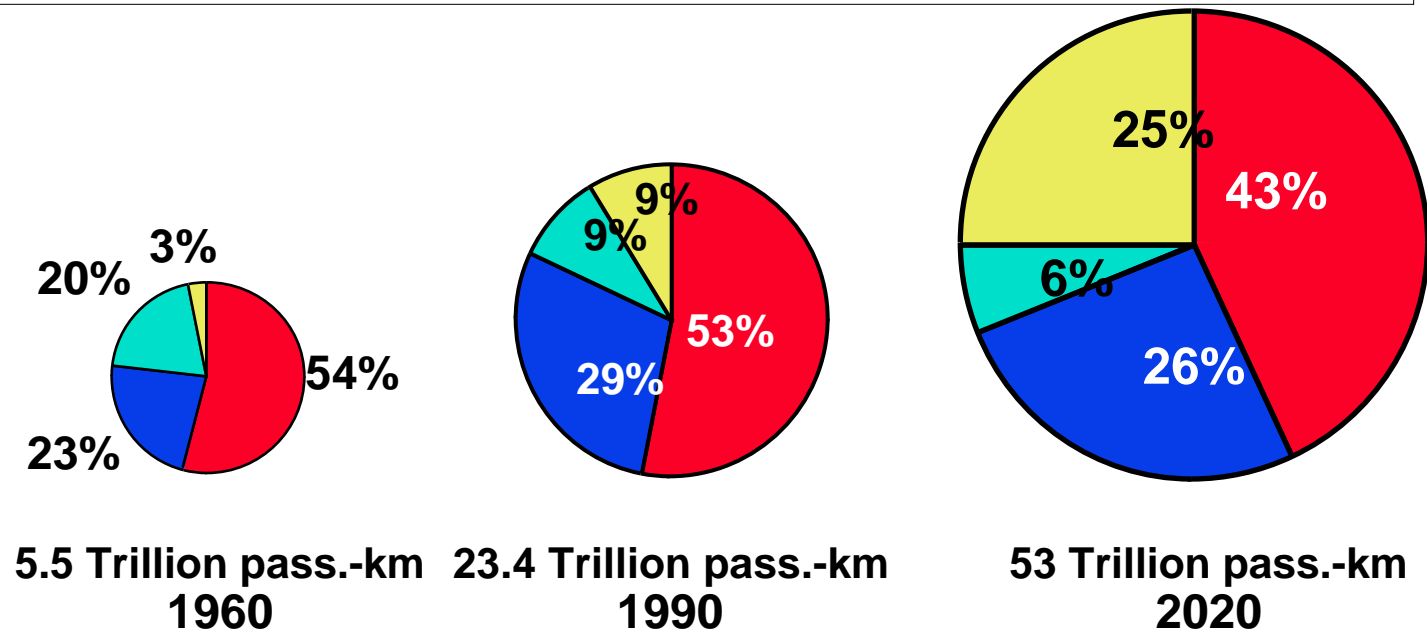
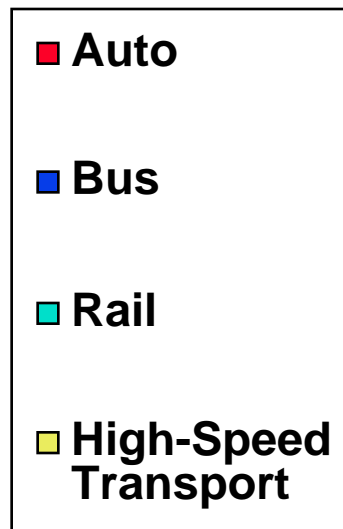
- The innate human desire for personal command of time and space creates demand for distributed (personal) transportation systems.
- The Information Age will usher in a new magnitude for the value of time.
- The Baby Boom generation's peak spending (traveling) period coincides with saturation of the hub-spoke airway and interstate highway systems.
- The Third Migration Wave (beyond the suburbs), coupled with telecommuting, creates new transportation demand and challenges.
- The revolution in digital bandwidth redistributes intelligence from centralized to distributed system nodes, enabling the aviation transition from centralized to distributed air traffic management (free flight).

The Pig in the Python



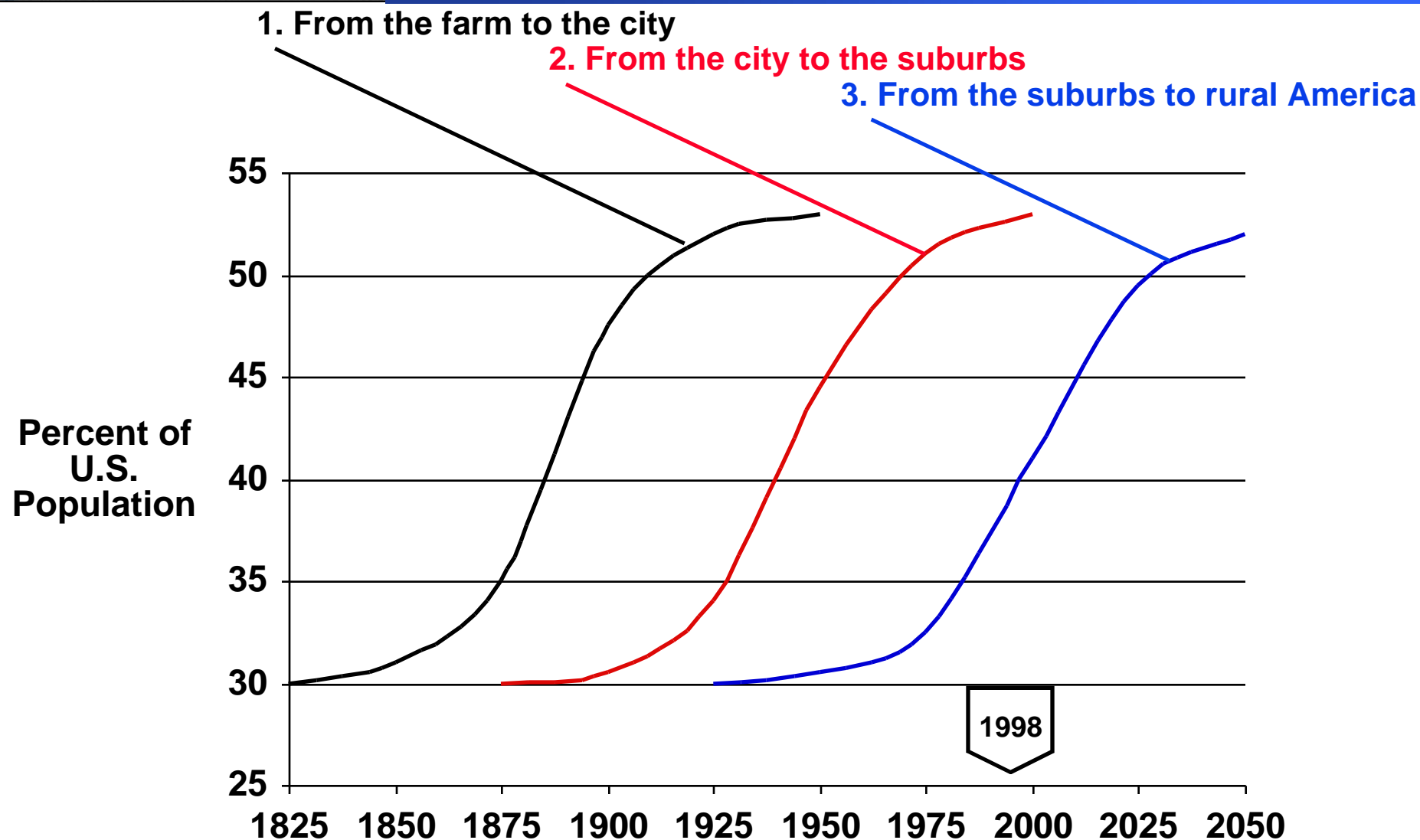
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**As per capita income rises,
per capita annual travel rises,
personal daily travel time budgets remain constant,
and
high-speed modes gain market share
(Schafer and Victor, Sci. Amer., Oct. 1997)**



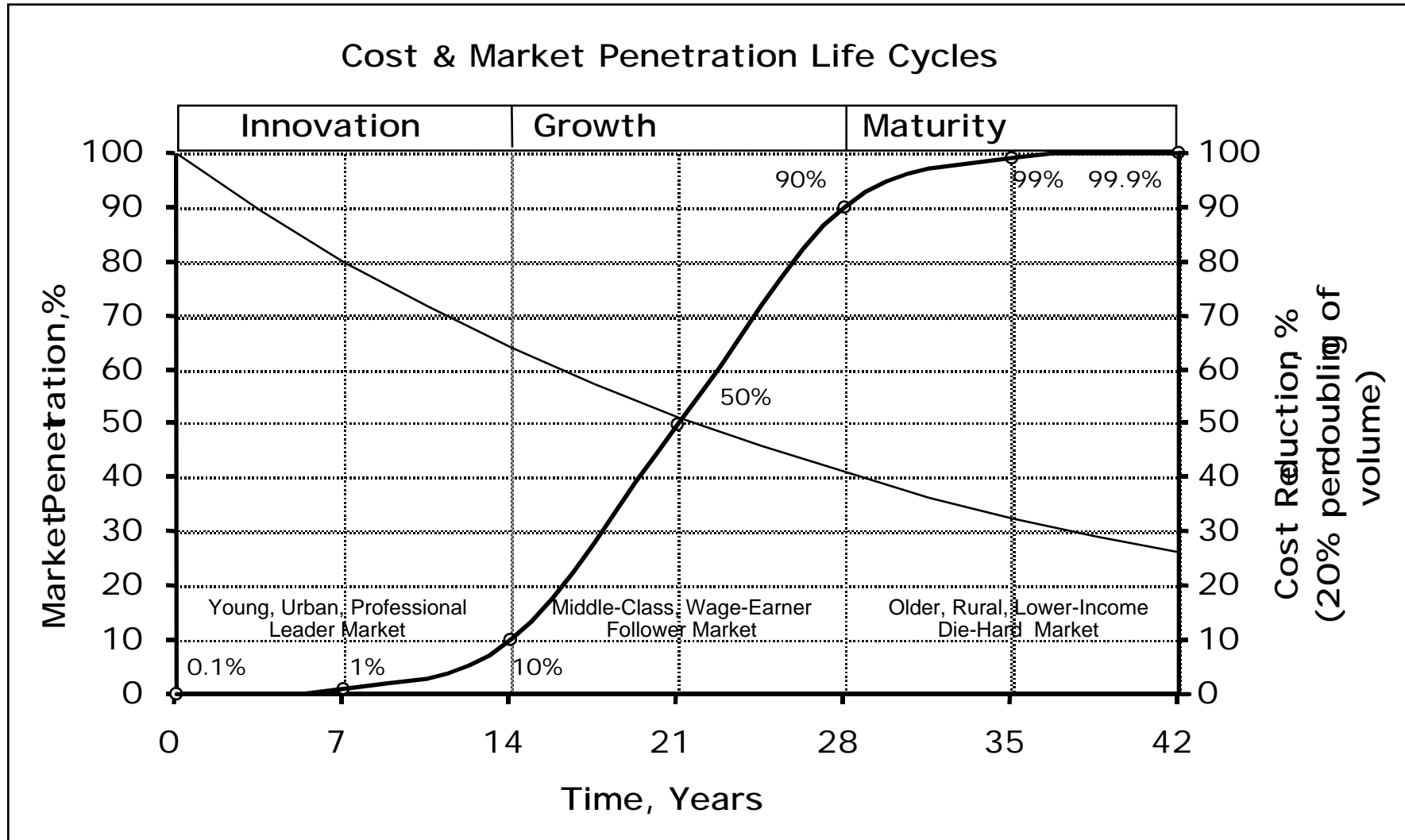
**Global Travel Mode Shares will be driven by
the largest population and spending wave in history:
The Baby Boom**

The Third Migration Wave



Innovation and Cost Life Cycles

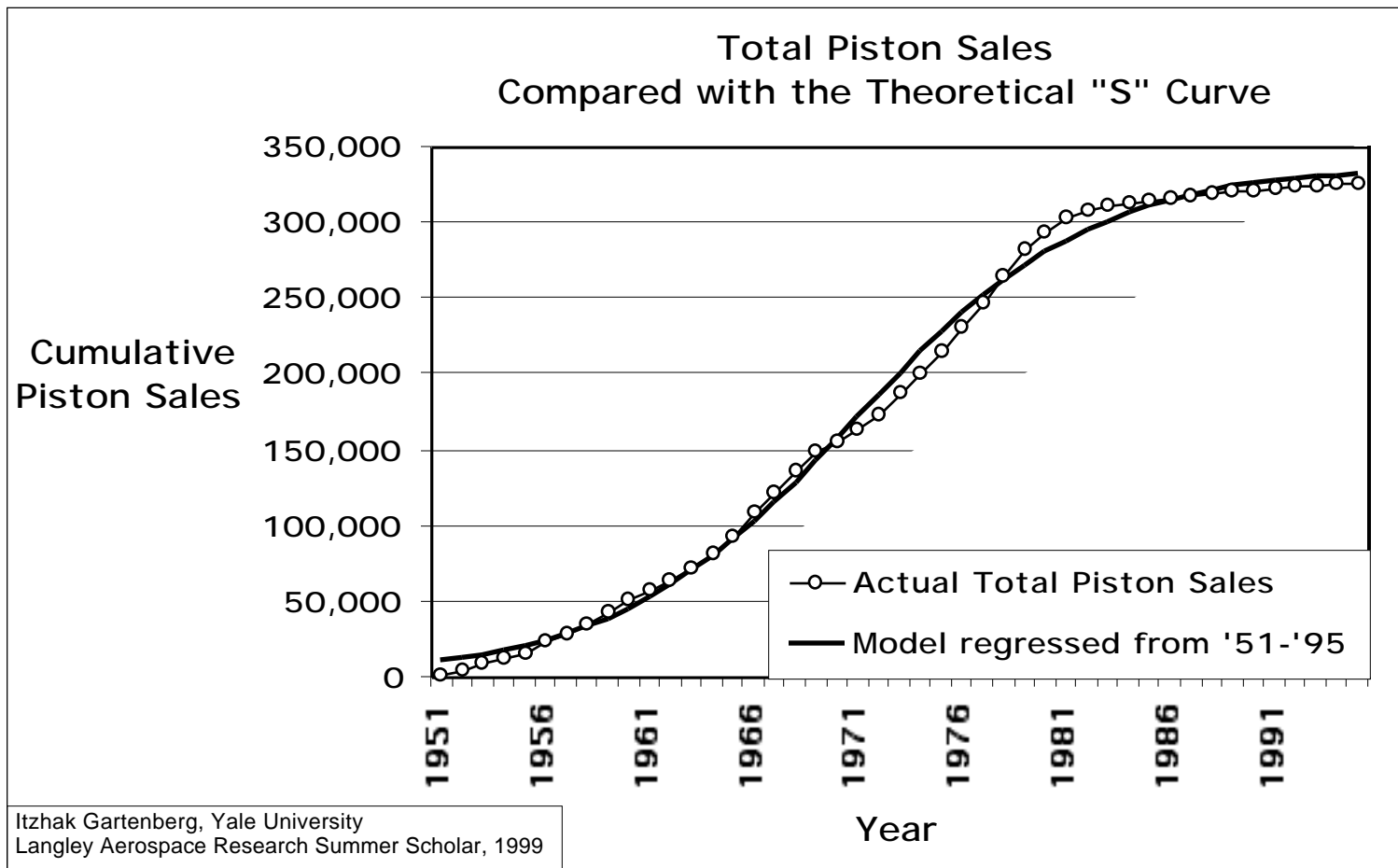
(Trends follow classic “S-Curve” for innovations, Hugh B. Stewart, *Recollecting the Future*, 1988)



Life Cycle of the Piston Aircraft Market



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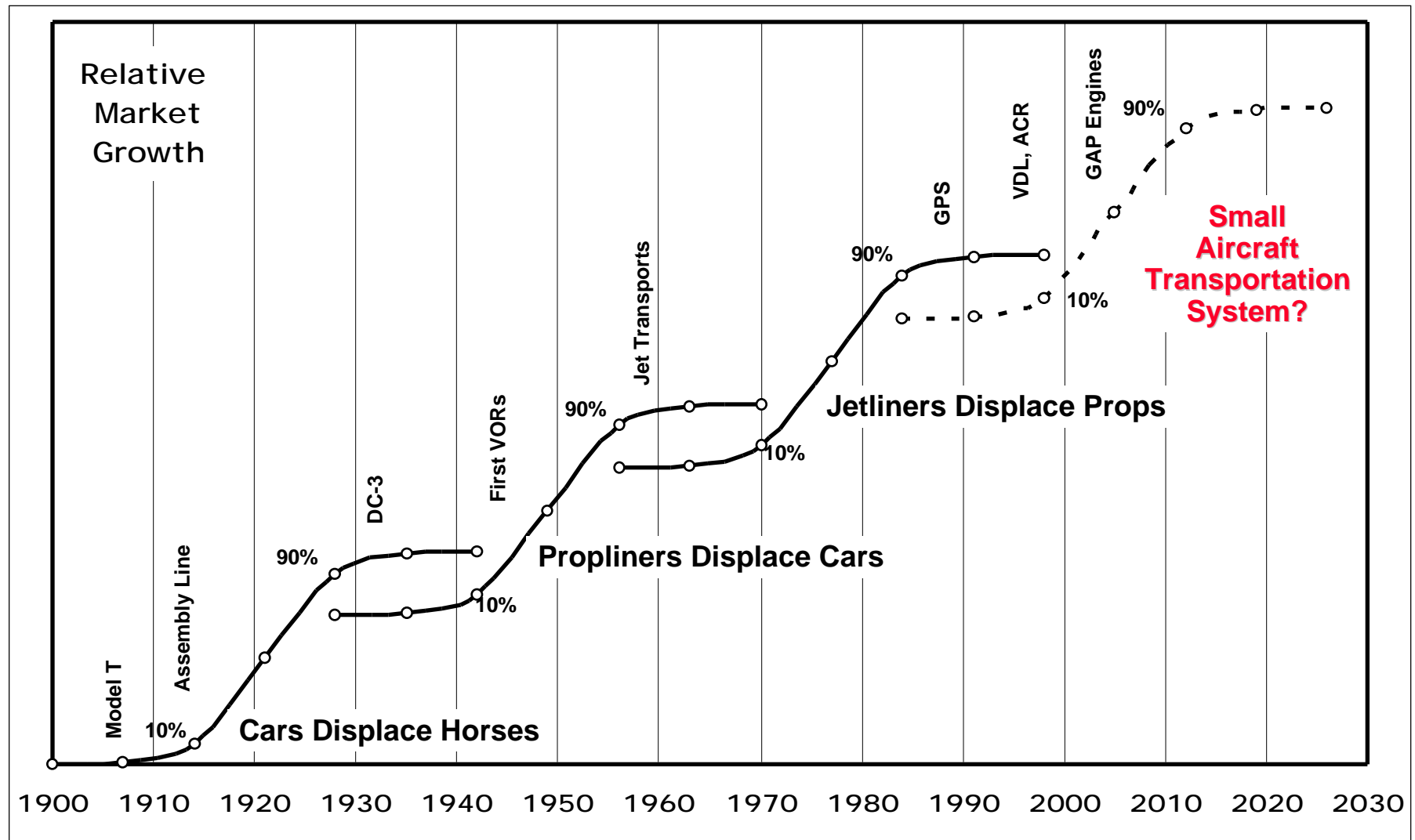
(R)evolutions in Higher Speed Travel

What is Next? More Speed to More Destinations



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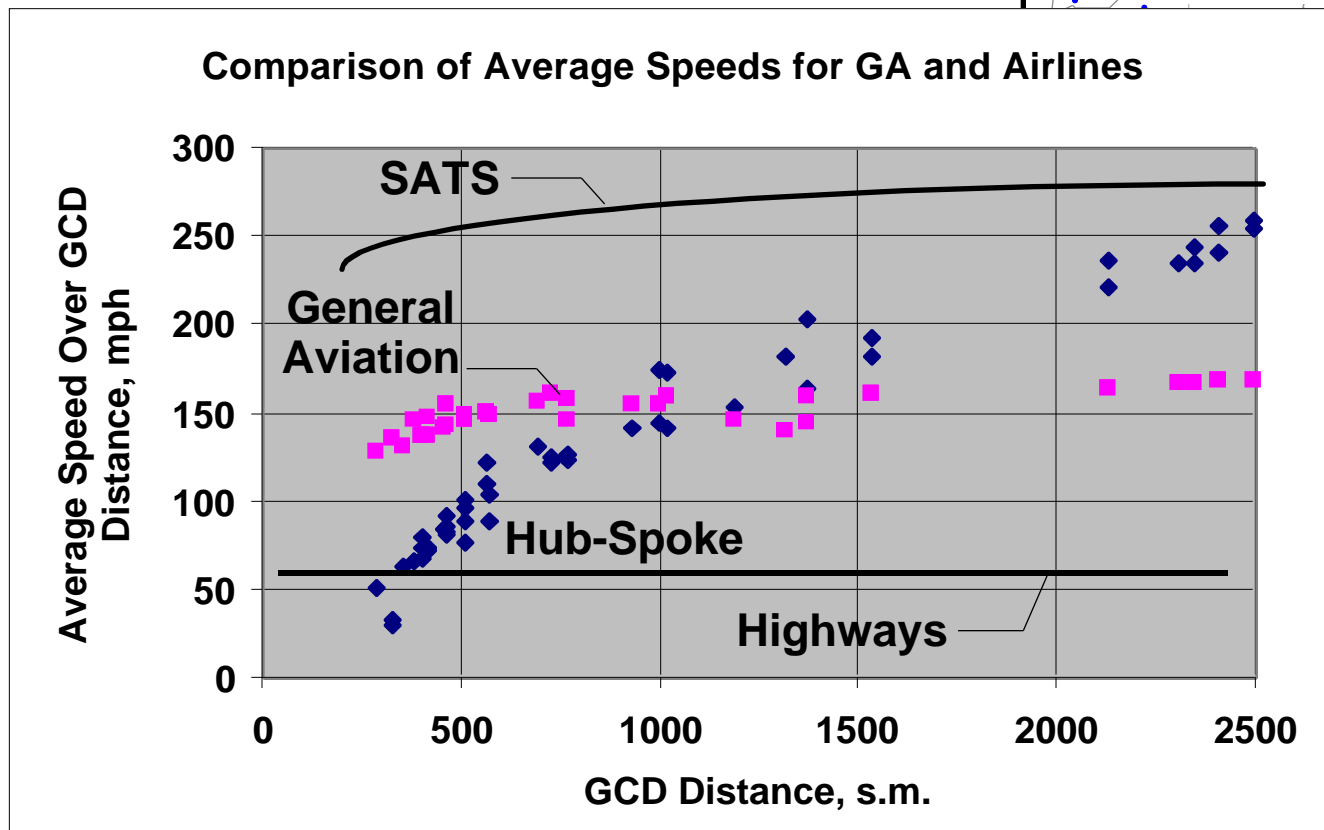
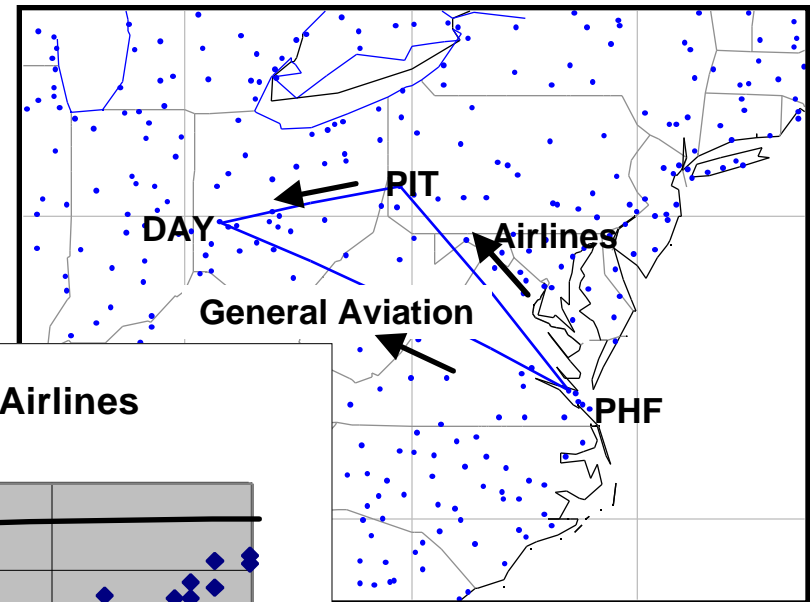
The “Atomic Structure” of Business Innovation Cycles



Small Aircraft Transportation System Mobility

"...doorstep-to-destination at four times the speed of highways..."

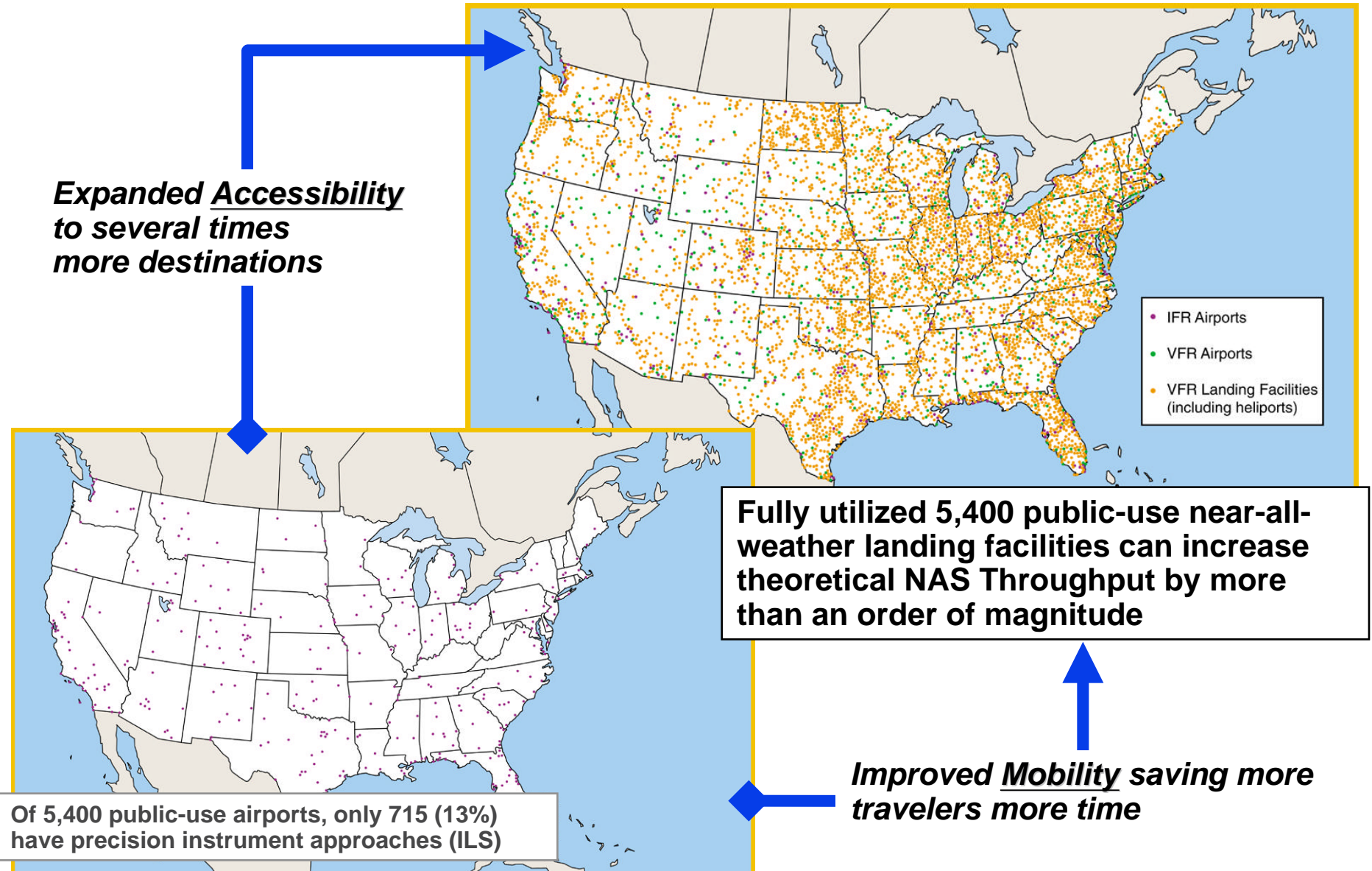
**SATS reduces travel times,
while highways and Hub-and-spoke travel
times
will continue to increase.**



- Hub-Spoke: OAG times for 28 destinations
- General Aviation: time-optimized flight plans
- Including intermodal penalties (:45 +:45 for airline & :30+:30 for GA departure & arrivals)
- No GA destination benefit (for proximity of airports)
- SATS with new GAP engines: costs equal current General Aviation at 2 times the speed.

SATS Increases Accessibility and Mobility

(“. . .creating access to more communities in less time. . .”)



Current States Roles in SATS Planning

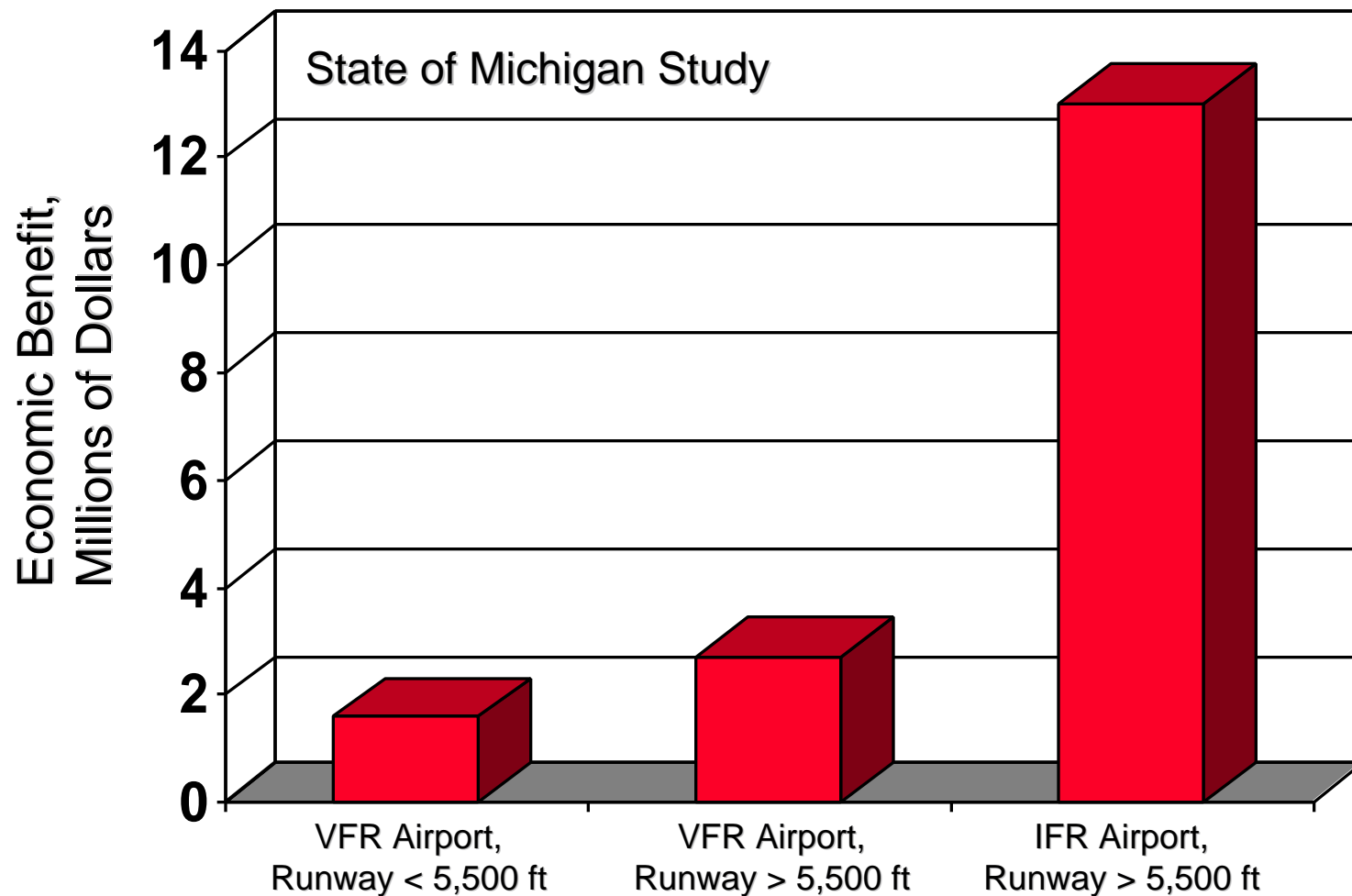


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- **SATS “Leader” States Committed to Support Program Planning**
 1. Virginia
 2. Florida
 3. Nebraska
 4. North Dakota
 5. Oklahoma
 6. Kansas
 7. Illinois
 8. Indiana
 9. Wisconsin
 10. Washington
- **Aerospace States Association SATS Resolution, July, 1999**
- **Leveraged Research Funding:**
 - EPSCoR funding leveraged (e.g., Nebraska, Kansas)
 - NASA Space Grant Program potential leveraging
 - SBIR / STTR leveraging



All-Weather Accessibility Means Economic Development



VFR - Visual Flight Rules
IFR - Instrument Flight Rules

HITS System

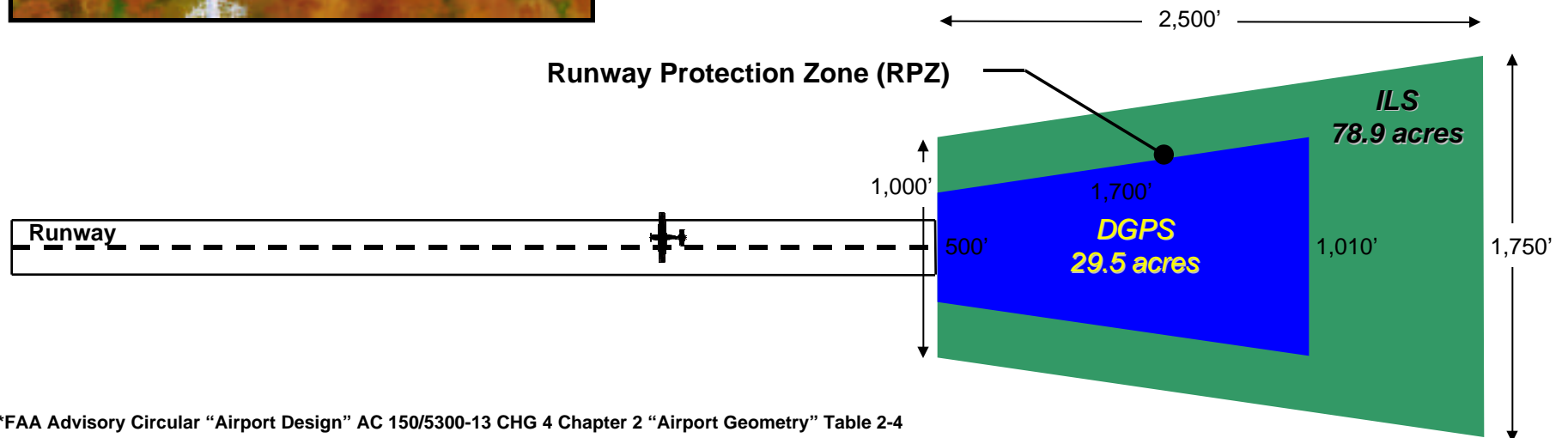
Lowers Cost, Minimizes Dislocation, and Increases Safety



A Highway in The Sky (HITS) DGPS-based approach guidance system may save over 49 acres per runway end compared to installing new ILS*



- Avoids land and system acquisition costs
- Minimizes dislocation of existing land holders
- Increases safety for operators and community
- Reduces noise outside of airport boundary



*FAA Advisory Circular "Airport Design" AC 150/5300-13 CHG 4 Chapter 2 "Airport Geometry" Table 2-4

SATS Accessibility = Economic Development



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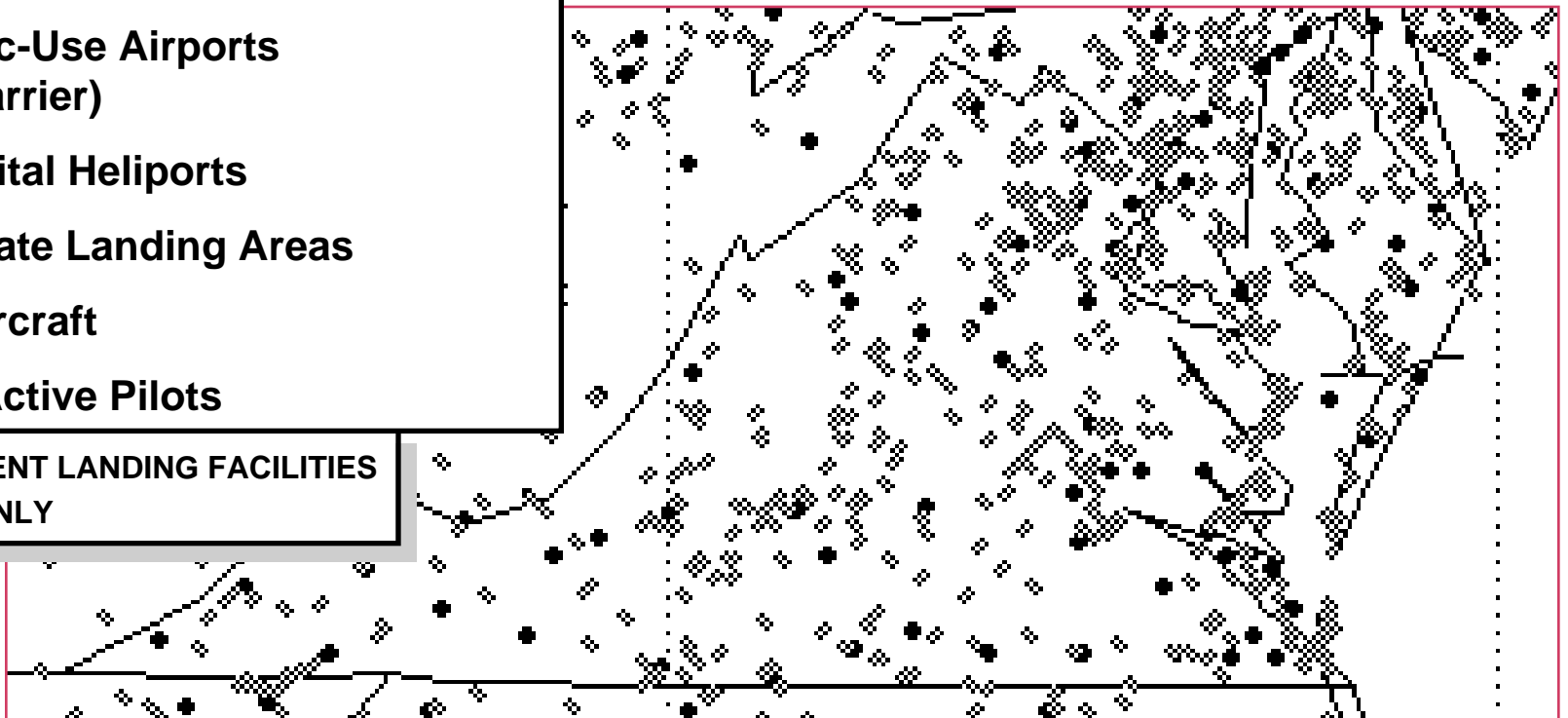
Example for one state

Virginia General Aviation Today

- ~\$175 Million in Economic Impact (Primary & Secondary)
- 2,400 jobs from General Aviation (Primary & Secondary)
- 68 Public-Use Airports (9 Air Carrier)
- 54 Hospital Heliports
- 227 Private Landing Areas
- 4,104 Aircraft
- 15,525 Active Pilots

- INSTRUMENT LANDING FACILITIES
- VISUAL ONLY

SATS will enable ~90% more accessibility by air for all Virginia's communities, expanding economic opportunities for all regions



A New Beginning

(Resulting from Current NASA Aeronautics Investments)



- **AGATE Alliance: 70 industry competitors collaborated under NASA leadership to create new, far-reaching technologies cockpit, airframe manufacturing, and flight training (1994 - 2001)**
- **Two newcomers represent the first new Single-Engine, Type-Certificated Airplanes in 15 years. Technologies derived from past 20 years of NASA Aeronautics research.**
- **Corporate commitments to new products and services signal the long-term potential for payoffs from these technology strategies**
- **Highway in the Sky (HITS) capabilities offer potential to deploy GPS/graphically guided approaches to all virtually all landing sites in the nation, leading to a 21st century Small Aircraft Transportation System**

AGATE/GAP Usher In A New State of the Art



Lancair Columbia 300



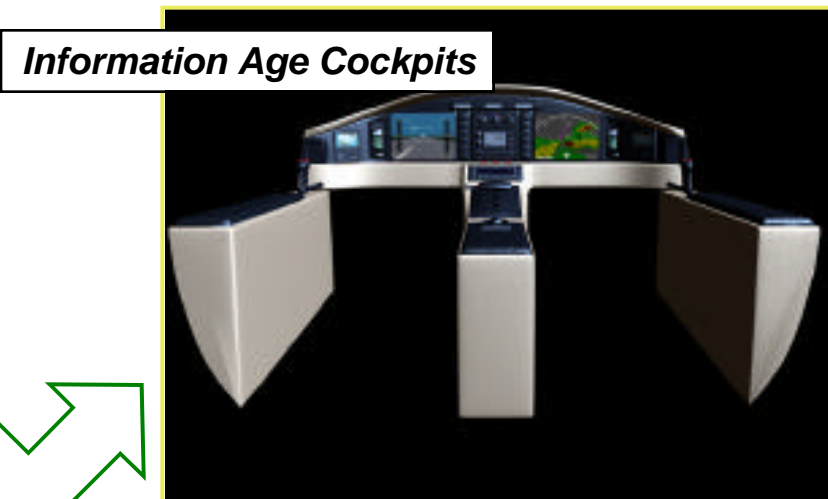
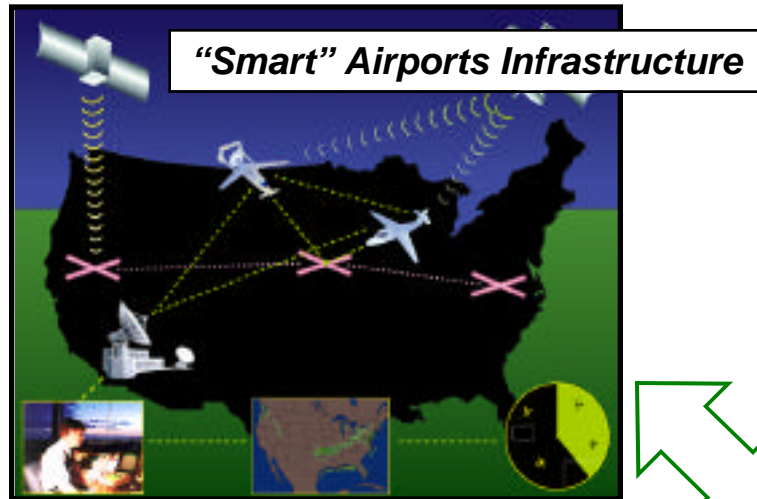
Williams V-Jet

The New Generation Cockpits and Aircraft

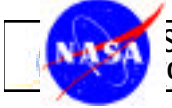
Cirrus SR-20



SATS Is a System Approach to Safe Transportation Utility



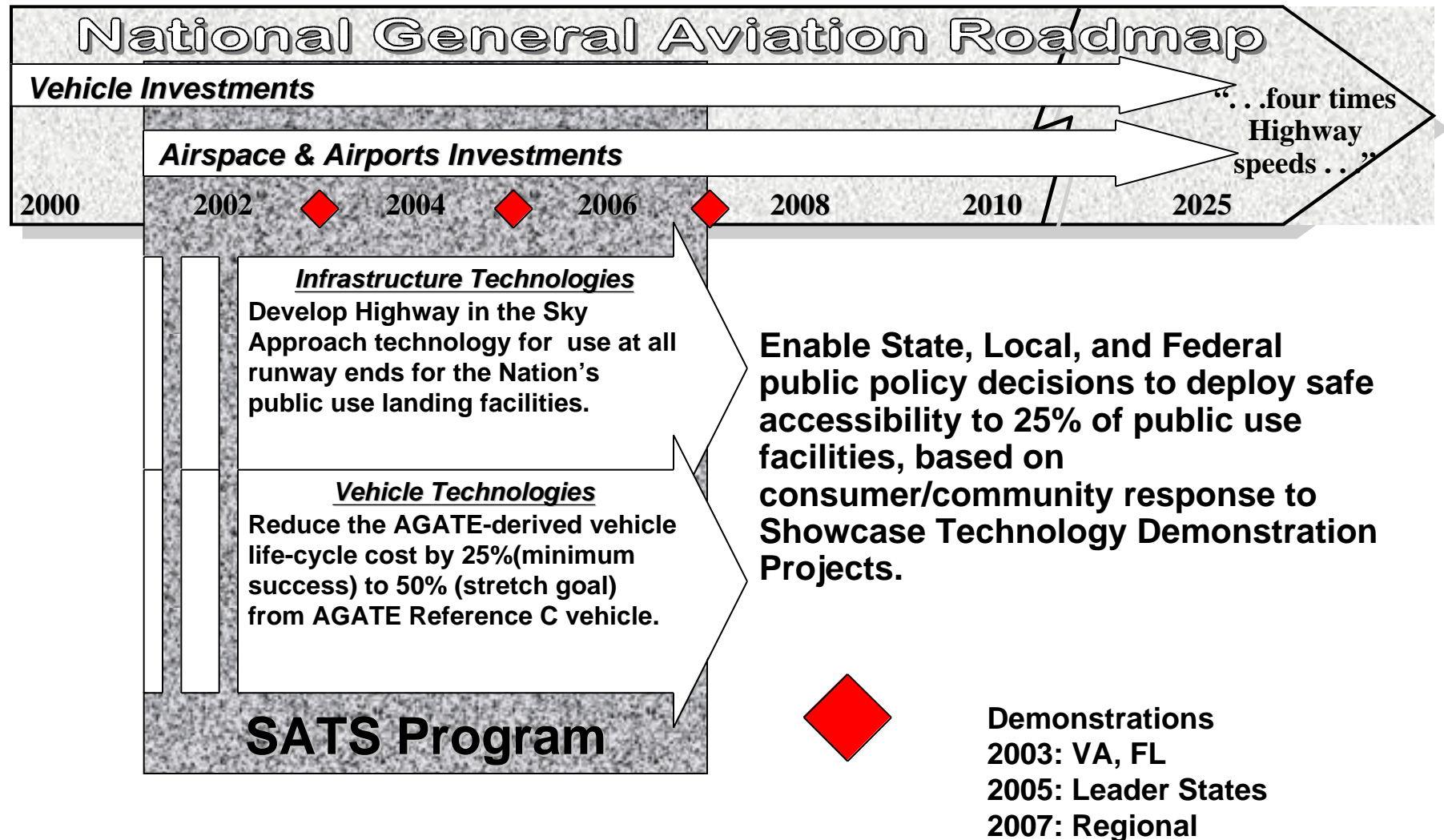
Technology Investments



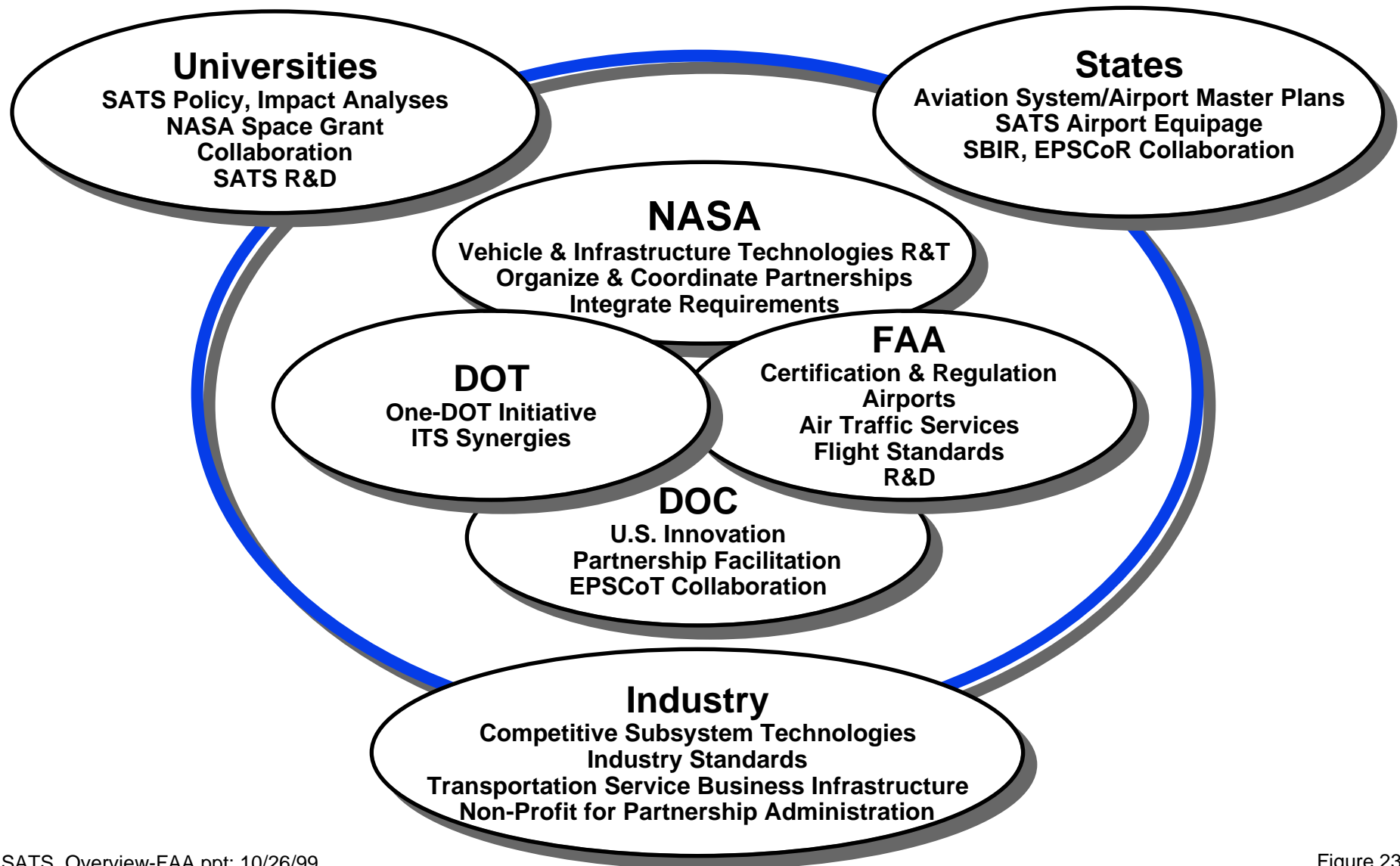
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- **Intermodal Transportation Systems** **Engineering**
 - *Program System Engineering*
 - *SATS Space Grant Partnerships*
 - *National Public Outreach*
- **Digital Airspace Infrastructure**
 - *Airborne Internet*
 - *Smart Landing Facilities*
 - *Runway Independent Aircraft Operations*
 - *Showcase Demonstrations*
- **Robust Air Vehicles**
 - *Autoflight*
 - *Affordable Manufacturing*
 - *Ultra-Propulsion*
 - *Wireless Cockpit*
 - *Cyber-Tutor*

Program Description



Candidate Federal-States SATS Partnership Roles



Joint Agency Planning Position



FAA/NASA Executive Committee

September 8, 1999

FAA Headquarters

Joint Agency Statement

SATS Program Description:

"The Small Aircraft Transportation System concept is a safe travel alternative that frees people and products from transportation system delays, creating access to more communities in less time."

Joint NASA-FAA supporting statements:

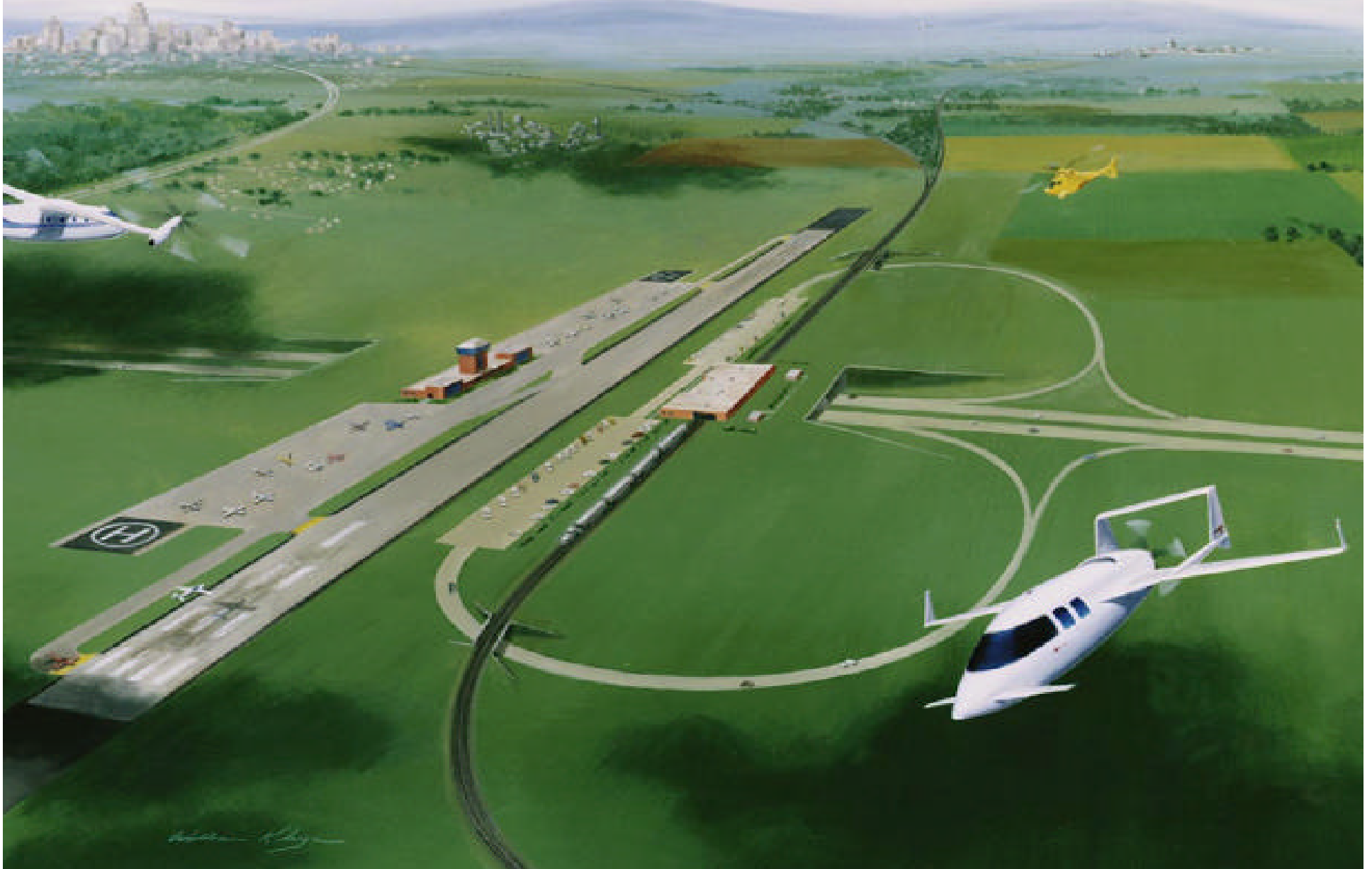
- FAA and NASA are working together to define a SATS operational concept as it relates to the transportation infrastructure of the U.S. and will begin a NASA funded research initiative to explore the feasibility and viability of implementing that concept.
- Under the charter of the NASA/FAA Executive Committee, the agencies agree to form a working group to define the FAA-NASA engagement in SATS program development and implementation planning

Conclusions

***“The Small Aircraft Transportation System is a safe travel alternative,
Freeing people and products from transportation system delays,
By creating access to more communities in less time.”***

- **SATS is an investment that preserves America’s options for mobility and accessibility in an era of saturation of the highway and hub-and-spoke systems.**
- **SATS investments build on a solid track record of accomplishment by American industry working in partnership with NASA and the FAA.**
- **SATS strategies strengthen the U.S. knowledge-based industrial expansion.**
- **SATS gives people more time = more quality of life.**

The Small Aircraft Transportation System is a safe travel alternative, freeing people and products from transportation system delays, by creating access to more communities in less time.





Backup Charts

MAJOR PROGRAM ACCOMPLISHMENTS (4/98-4/99)



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- **Program Analysis**
 - apats.org implementation
 - AGATE current & latent market measurement complete (analysis underway)
- **Flight Systems Work Package, LaRC**
 - AGATE Architecture implemented on AGATE 1B
 - VDL Mode 2 and 3 Datalink MOPS completed
 - Raytheon Bonanza AGATE 1B flight experiments ongoing
- **Propulsion Sensors & Controls Work Package, LeRC**
 - Single Lever Power Control/FADEC initial development completed
 - Propulsion management & diagnostic system initial design & testing completed
- **Ice Protection Systems, LeRC**
 - Laminar flow manufacturing tolerances established
 - Collaboration with ID&M on integral manufacturing established
 - Graphical icing condition avoid & exit products developed
- **Integrated Design & Manufacturing Work Package, LaRC**
 - AGATE material qualification process submitted to Mil HNDBK17
 - AGATE Crashworthiness Design Guide published
 - AGATE Lightning Protection Design Guide published
- **Flight Training Curricula Work Package**
 - Completed first classes of students in AGATE Unified Instrument-private pilot curriculum
 - Delivered Integrated Cockpit Information System Learning Module CD-ROM
- **FAA Team AIR AGATE**

Industry Successes

Over 1997, the 1998 industry trends continue a three-year pattern of growth:

- **Billings up over 25%**
- **Deliveries up over 41%**
- **Single-Engine Piston deliveries up over 58%**
- **Exports up over 24%**
- **Used aircraft sales up over 20%**
- **Student Pilots up over 12%**
- **Pilot licenses up over 22%**
- **IFR Ratings up over 37%**
- **Industry employment up >20%**
- **General Aviation Total and IFR operations up 2% and 4%, respectively**
- **1998 was the safest year on record (for both rates of accidents & fatalities)**
- **Warren Buffett's purchase of Executive Jet Aviation and Flight International, and Toyota's decision to enter the lightplane market signals long-term potential for payoffs from NASA technology strategy.**

SATS Planning Assumptions

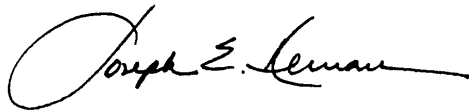
- **Alliance-based program**
- **Cost-sharing (50/50 model)**
- **Collaboration for pre-competitive technologies**
- **Competition for competitive technologies**
- **FY 2001 to FY 2008 program with major demonstrations on 2-year centers**
- **FAA SATS Mission Need Statement influences NAS Architecture (5.x)**
- **U.S. industry and States will meet the challenge**

Resolution of the Aerospace States Association

RESOLUTION REGARDING THE PROPOSED SAFE SMALL AIRCRAFT TRANSPORTATION SYSTEM (SATS)

- **WHEREAS** a variety of forces are converging to reduce the effectiveness of the nation's existing highway and hub-spoke air transport system to meet the growing needs of short distance, inter and intra-state travel; and
- **WHEREAS** these forces include the maturing of the hub-spoke air transport system, the increasing gridlock on the nation's highways, and the increasing value of human time; and
- **WHEREAS** the nation has an existing infrastructure of 17,000 airports for small, General Aviation Aircraft, of which at least 5,000 could be modified to meet the nation's emerging short distance transportation needs; and
- **WHEREAS** the Federal Government, acting through NASA, has undertaken cooperative technology development efforts with the nation's General Aviation industry to develop a new era of aircraft capable of effectively using these 5,000 airports; and
- **WHEREAS** the investment in, and control of ground infrastructure associated with such airports is under the jurisdiction of the nation's State and local authorities; and
- **WHEREAS** the Federal Government has offered to develop, with State governments, the means to upgrade those 5,000 airports with new capabilities, such as Global Positioning Systems (GPS), and link them together into a system to be known as the Small Aircraft Transportation System (SATS); and
- **WHEREAS** the development of a SATS has the potential to generate transportation-driven economic development benefits; and
- **WHEREAS** the coordinated development of a SATS would be of substantial benefit to the State governments in meeting the transportation needs of their citizens; and
- **WHEREAS** it is the purpose of the Aerospace States Associations to identify, support, and assist in the implementation of aerospace policies which involve coordination between the Federal and State governments,
- **NOW THEREFORE, BE IT RESOLVED** that the Aerospace States Association endorses and supports efforts by the Federal Government to undertake the planning and implementation associated with the creation of a Small Aircraft Transportation System (SATS).

by a unanimous vote of the members voting.



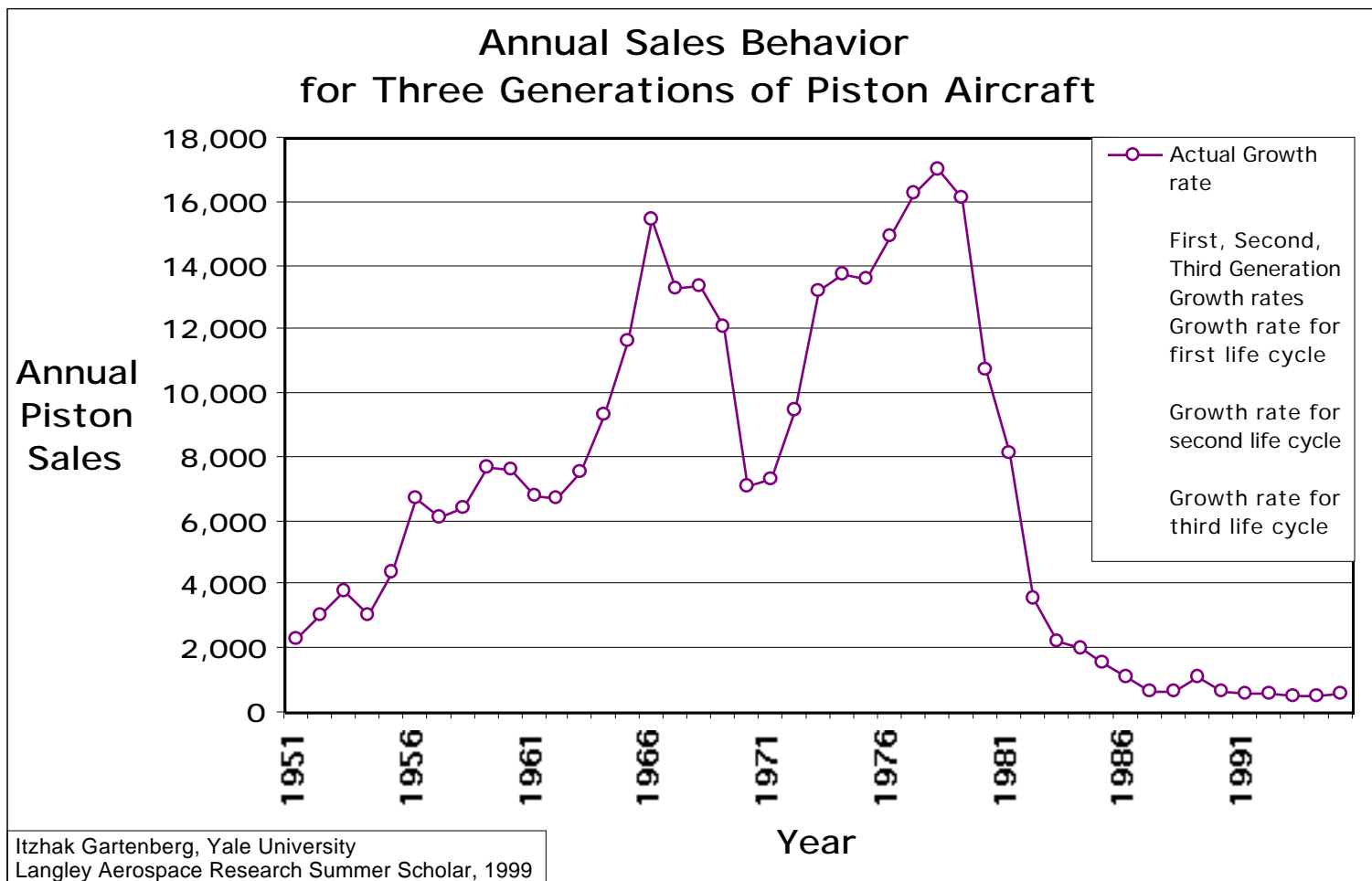
The Honorable Joseph E. Kernan (Lt. Governor, Indiana)

Chair

Life Cycles for Three Generations Piston Aircraft



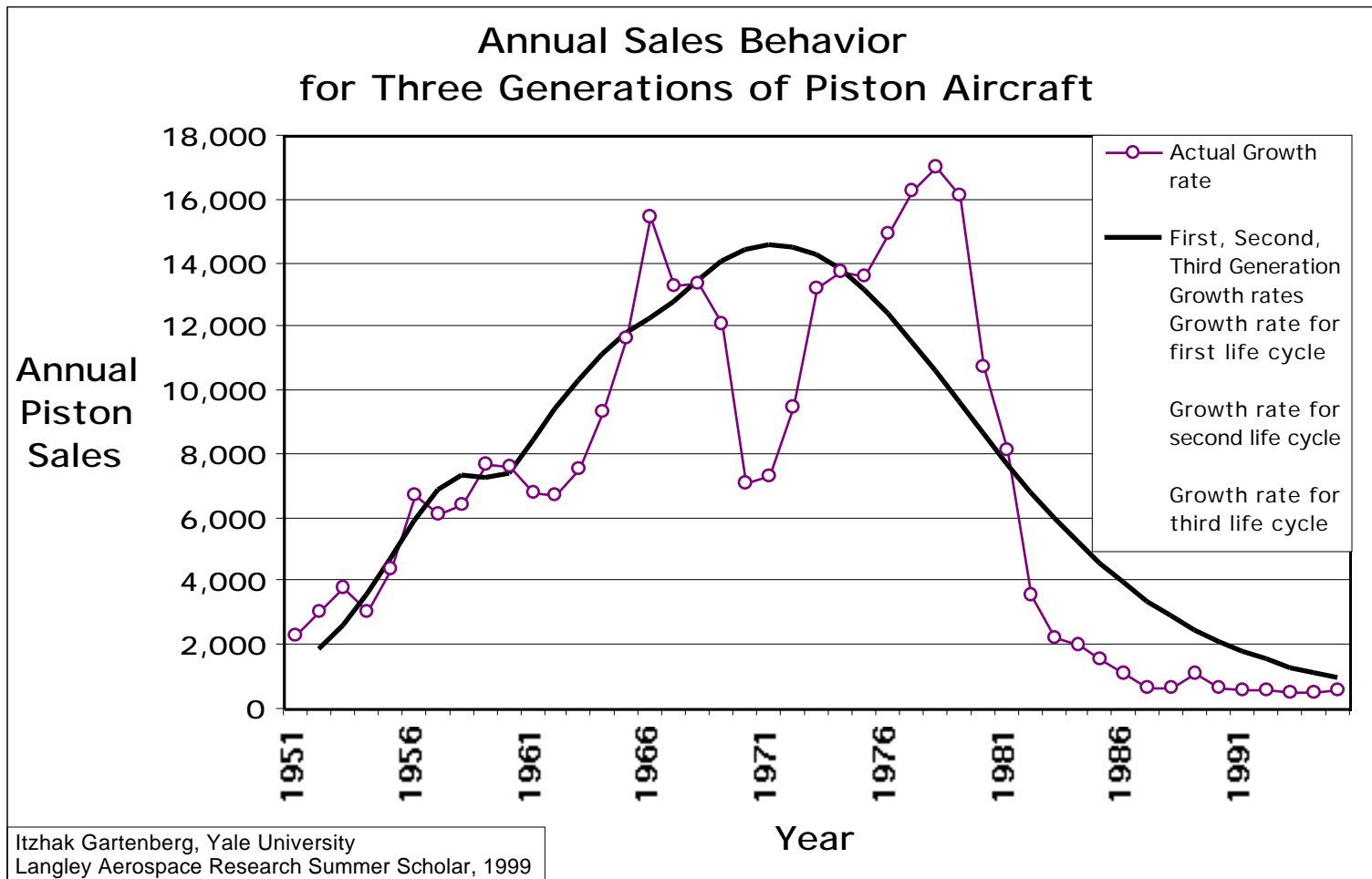
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Life Cycles for Three Generations Piston Aircraft



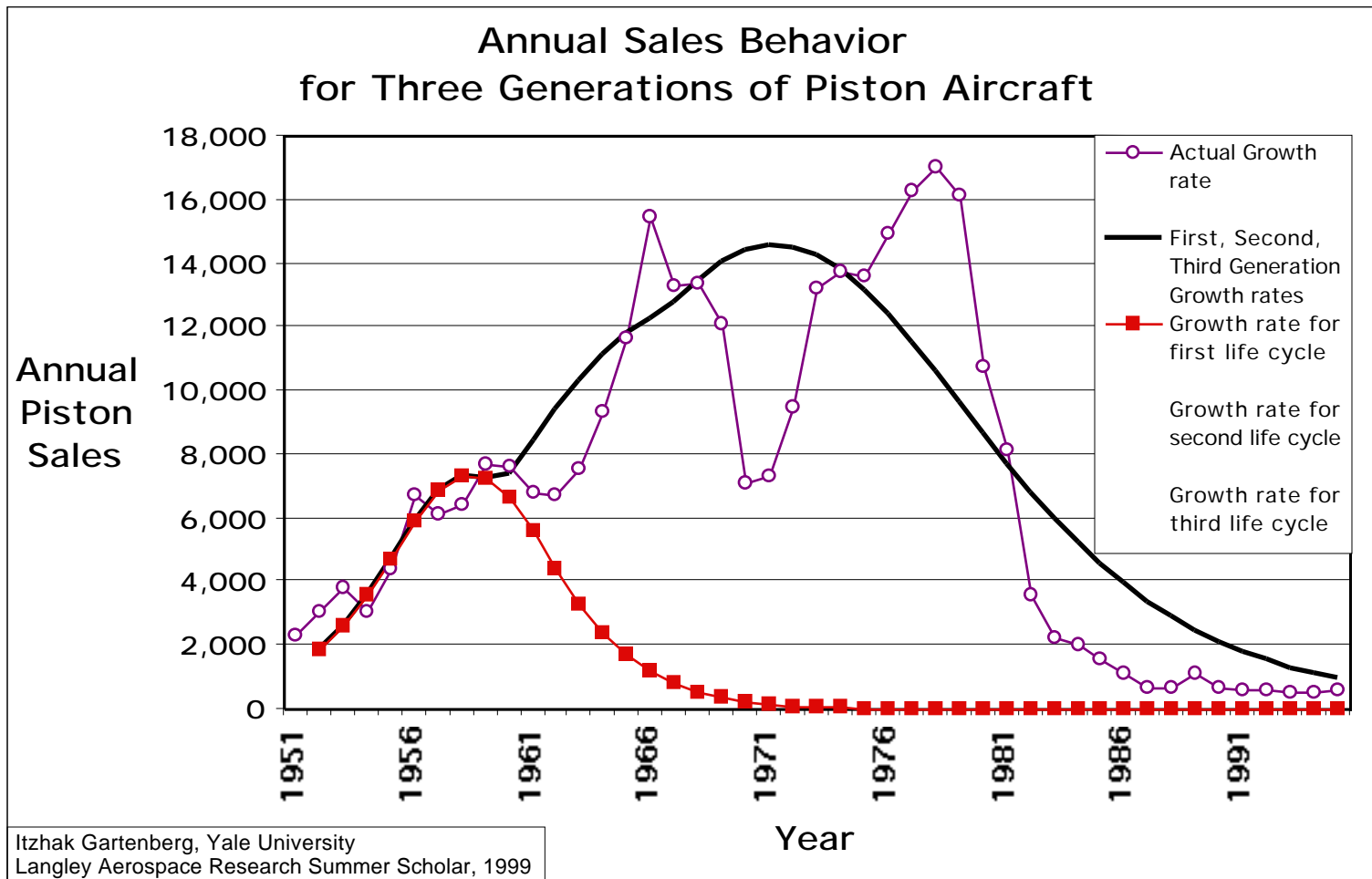
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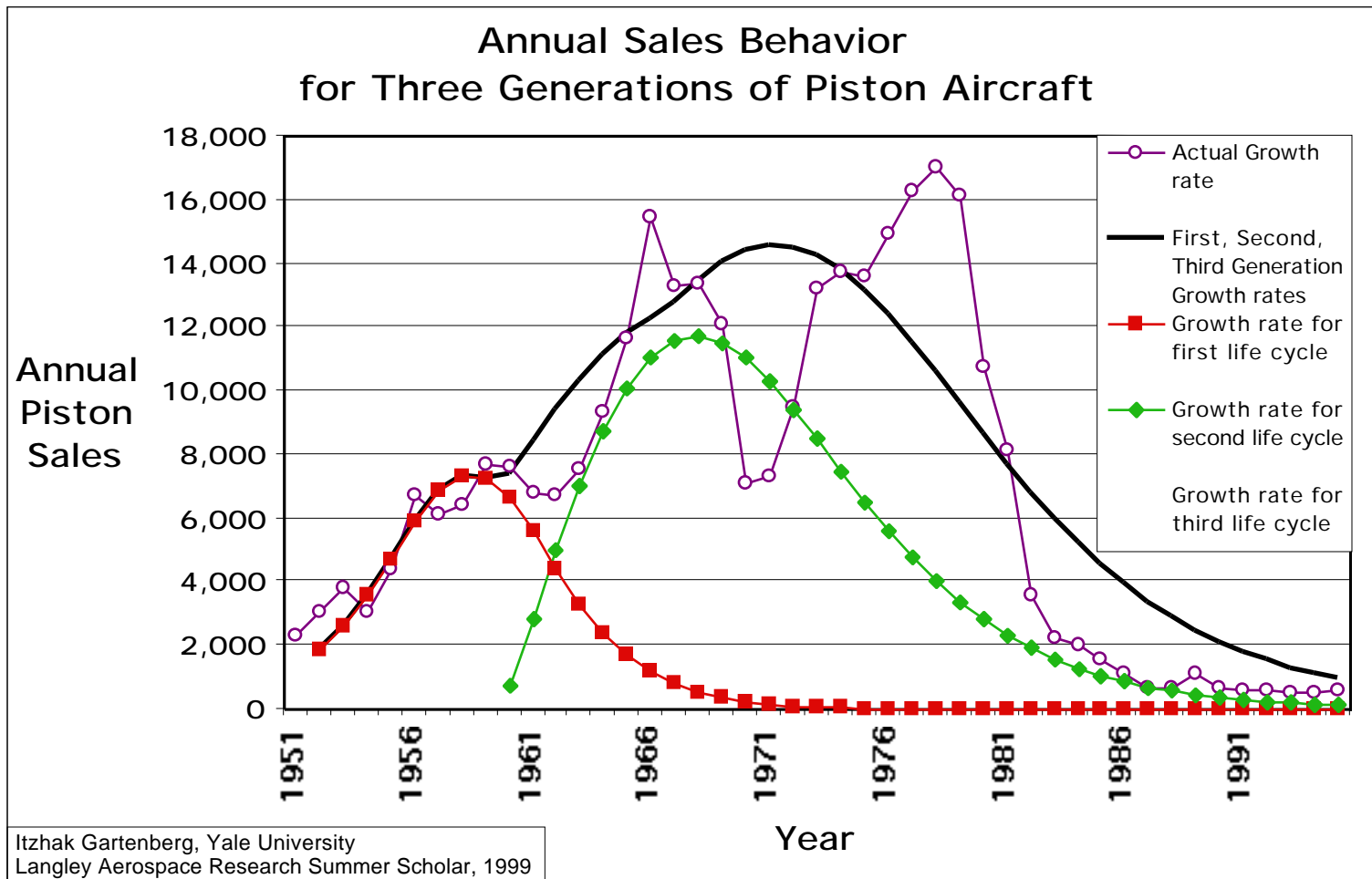
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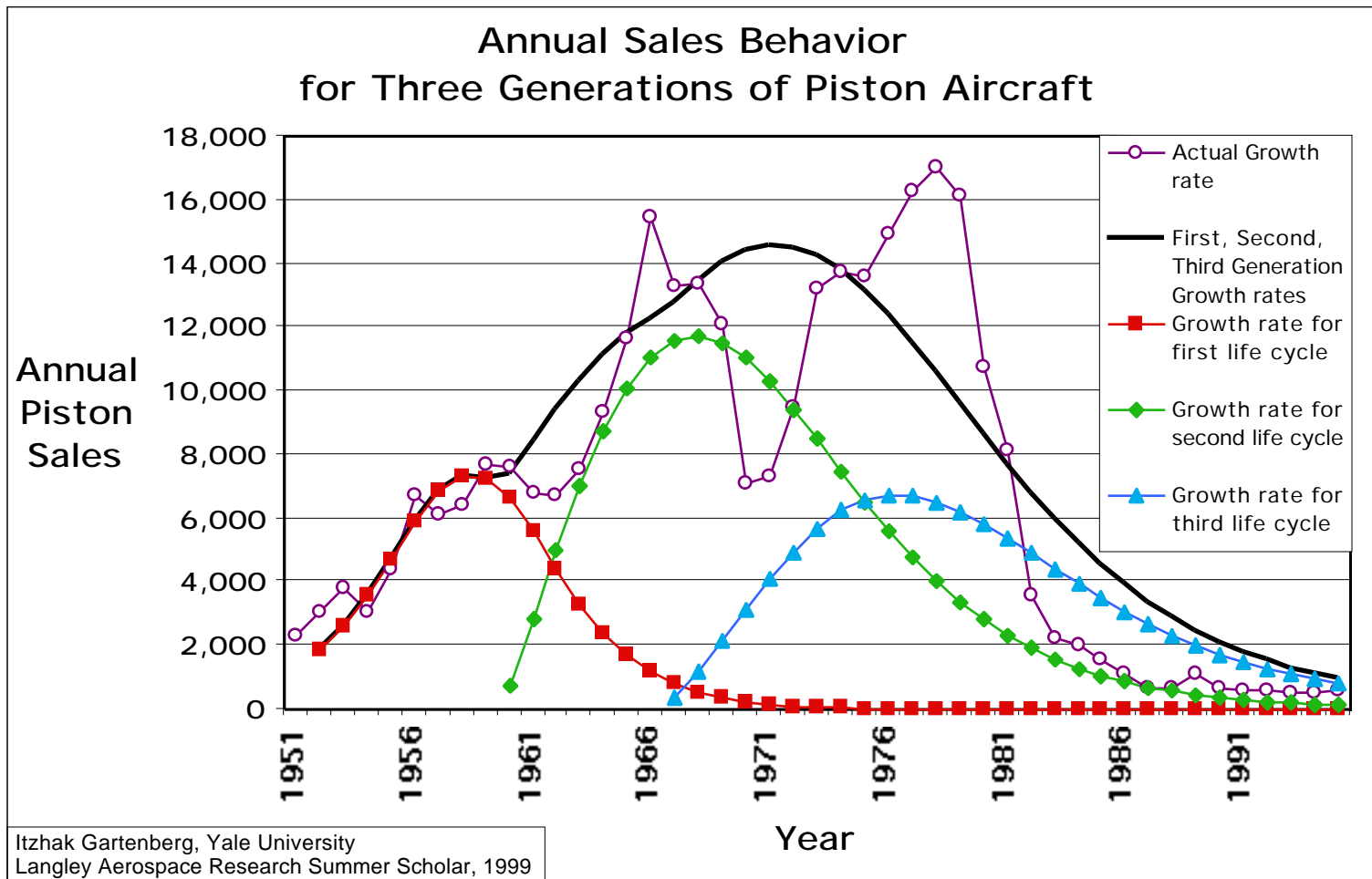
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Life Cycles for Three Generations Piston Aircraft



SATS Milestones FY 2000 - 2005

